A Modular Distributed Driving Simulation Platform using HLA
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Background – SimArch final report (2010)

SimArch purpose and goal

”The purpose of SimArch is to define a general platform for the interaction between driving simulators, vehicle simulators and environment simulators.”

”The most important properties of SimArch are modularisation and standardisation, which will give scalability and flexibility.”
Background – SimArch final report (2010)

Why do we want something like SimArch?
”Driving simulators in Sweden should be compatible, so experiments can be easily moved from one experiment system to another.”

Results from SimArch?
• Final report with architecture description
• A prototype demo between Sim II & Sim III
Driving simulator examples

low  med  high
Motivation

SimArch 2, same same but different?

"The project will realise the **core technology base** for the SimArch system, incorporating existing HLA functionality." — Expected result from SimArch 2 ViP application

Possibility to use distributed simulation and test "connected vehicles" scenarios.
Architecture overview

Modularisation
- Session Control
- Environment Simulator
- Driving Simulator
- Vehicle Simulator

Communication
- HLA Evolved (IEEE 1516-2010)
Modules

**Session Control, SC**
- simulation control and handles simulation states

**Environment Simulator, ES**
- environment, traffic and scenarios

**Driving Simulator, DS**
- physical simulator with cabin and driver

**Vehicle Simulator, VS**
- vehicle model
Modules – an example from VTI

vsim12

core

libvti
cabin
visual
sound
scenario
traffic
opendrive
util
...
Modules – an example from VTI

SC
- HLA

ES
- libvti
- scenario
- traffic
- HLA
- opendrive

DS
- cabin
- visual
- sound
- facility
- HLA

VS
- vehicle model
- HLA
- simulink
- fortran
- modelica
Communication

How do we connect modules?
Standardised interfaces.
Communication

High-Level Architecture (HLA) Evolved

- High-Level Architecture (HLA) Evolved is an IEEE 1516-2010 standard for communication.
- Each entity within HLA is a federate and the complete set of federates forms a federation.
- The communication is handled by a publish and subscribe architecture.
- Interfaces are defined in a Federation Object Model (FOM) which contains both classes and interactions.
- A federation agreement documents data used within the federation, e.g. coordinate systems used.
Communication – example

HLA objects used during a simulation
Overview
Overview of the architecture

- ES (Environment simulator)
- SC (Session Control)
- DS (Driving simulator)
- VS (Vehicle simulator)
Demo setup in Linköping 2015-12-09

VTI

Desktop
- DS
- VS

ES

Sim II
- DS
- VS

Sim III
- DS
- VS
Demo setup in Linköping 2015-12-09
Demo setup in Linköping 2015-12-09
Demo setup in Linköping 2015-12-09
Demo setup in Gothenburg 2015-11-12

VTI

Desktop
- DS
- VS

ES

Sim IV
- DS
- VS

VCC HIL
- DS
- VS

SC
Testing the platform

• Different distributed set-ups have been tested and they have all worked.
• Tests were done in different configurations using the locations Linköping, Gothenburg (both at VTI and at VCC) and Paris.
• Simulators tested include SimFoerst, Sim II, Sim III, Sim IV and the VCC HIL.
• Haven't investigated effects of simulation time delays with distributed DS and VS.
Testing the platform

RTT tests during the night using Sim II and Sim IV.

RTT median value range of 1.06 ms to 1.14 ms in Sim II and 12.56 ms to 12.67 ms range in Sim IV.

Using ping to estimate the connection the latency it was approximately 0.25 ms in Sim II and approximately 11.5 ms in Sim IV.
Our experience

• The new platform has shown to be more flexible and scalable.
• Clear interfaces are beneficial, also as documentation.
• Time latency of 1 ms from HLA overhead needs to be considered.
• Total code base increases but separate modules can be seen as black box.
• Need for tools to ease the process of handling the distributed communication.
• So far increased flexibility and scalability has been seen more important than added complexity.
THANK YOU!

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